Center for Independent Experts (CIE) Independent Peer Review Report on *SaKe* acoustic-trawl survey

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February 2014

Executive Summary

A review was conducted of the historic biennial and alternating Pacific sardine and hake acoustic-trawl surveys as they led to the 2012 and 2013 SaKe combined surveys, as detailed in the Statement of Work (Appendix 2). The review included a literature review and a meeting with administrators, scientists and representatives of industry held in Seattle in January 2013. The primary reason for the implementation of the 2012 SaKe survey was the low biomass in the 2011 hake only survey and the impacts this could have on stock assessments and hence commercial quotas. The initial 2012 SaKe survey piggybacked the hake survey onto the scheduled pelagic survey that would have been conducted that year. The hake estimates were significantly higher in 2012 than in 2011, thus alleviating fears of stock decline. This history demonstrates the value of annual surveys, not only because of the periodic and unpredictable recruitment to both stocks, but also because of "year effects" from uncertain causes that impact survey results. The combining of these surveys has potential to provide annual estimates for both sardine and hake, in addition to ecosystem research on factors that regulate productivity of the commercial species and improving survey designs and analytical methods. A version of this strategy that will lead initially to a multi-species survey and evolve to a more comprehensive coastal fisheries ecosystem is highly recommended.

The personnel, scientific equipment, facilities and research vessels available to undertake this work are first-class. There is no reason based on an examination of these factors that these surveys cannot be conducted. The sole caveat is concern about workloads and priorities of the individual scientists and technicians involved. Nonetheless, the resources attached to these surveys are ample by any standard (potentially 2 U.S. vessels, 80 days ship-time per year, and exceptional personnel). Productivity from these surveys is evident in fulfilling stock assessment requirements and in primary publications addressing ecosystem factors with sardine and hake in the California Current Ecosystem.

A 2-stage implementation strategy is recommended. The first 5-year stage includes full surveys in even years (2014, 2016, 2018) and combined less intense surveys and research in the two odd years (2015, 2017). The research vessel *Lasker* would be brought into the work in 2015, with a less intense, trial survey of U.S. waters (both vessels starting at a common area in the middle of the range and one then going north and the other south). In the full survey years the Canadian DFO component of the survey would continue, and a Mexican component may also be possible. The objectives of the first stage are to conduct surveys that will inform stock assessments of Pacific sardine and hake in particular, but also, and equally important, to research the ecosystem dynamics important to productivity in these (and other) species, and research a survey design for the 2nd stage that can be done annually and continue to meet stock assessment and ecosystem research objectives. The survey design should contain sufficient flexibility (the research years should allow this) so that changes in the species

composition (e.g., Pacific sardine may decline further, possibly with increases in anchovy, hake may move further north, at least in some years).

An initial focus should be on making better use of the resources that are now available. This includes both existing data and future ship-time. There appears to be a reasonable likelihood that the present SaKe design over-samples the distribution of at least the main species. Over-sampling adds little to the survey products but uses up time that could be used for ecosystem-based sampling. The existing survey data can provide much needed assistance with decisions on survey design. This includes but is not limited to transect intensity (spacing) and its impact on survey biomass estimates and their precision and the use of the U.S. only data as an index of stock state.

Research that may require specific experimentation at sea includes better determinations of migration rates of Pacific sardine and hake, target strengths and their dynamics of key species, species identification from echograms and catchability characteristics of the nets used during the surveys, and boat avoidance.

The opinions expressed in this report are entirely my own. They are based on my own experience with acoustic-trawl surveys and stock assessments, readings of the literature, study of existing and planned surveys and research, discussions with administrators, scientists and industry representatives at the Seattle meeting, and with the CIE review team both at the meeting and in private sessions.

Background

The Southwest Fisheries Science Centre (SWFSC) has conducted independent acoustic-trawl surveys for coastal pelagic species (CPS) in the California Current ecosystem biennially in 2006, 2008 and 2010. There have also been spring surveys designed to target Pacific sardine during their spawning season when they are presumably more aggregated (e.g. Figure 1). Both these surveys were intended to provide distribution and biomass estimates (relative or absolute) to inform stock assessments of several species, but primarily Pacific sardine, which has been the main commercial species surveyed. These surveys, their methods and results, have been reviewed in the recent past. The CPS survey was reviewed by a Center for Independent Experts (CIE) panel in 2011, and although that report recommended additional research be undertaken on various aspects of the survey design and methodology, including species distribution and range relative to the surveyed area, target strengths of some species and boat avoidance of pelagic schools, for the most part the review found the survey to conform to high standards of practice for acoustic-trawl surveys and that the abundance estimates for Pacific sardine in particular could be regarded as absolute estimates, which is the highest standard for acoustic biomass estimates. Documents provided by NOAA and reviewed are listed in Appendix 1.

It should be noted that for the Pacific sardine stock assessment, four indices of relative abundance from ongoing surveys have been included in the base model: daily and total egg production estimates of spawning stock biomass off CA (1994-2012), NWSS aerial survey estimates of biomass off OR and WA (2009-2012), and acoustic-trawl method (ATM) estimates of biomass along the west coast (2006-2012). The catchability coefficient (**q**) has been fixed to a value of 1 for the ATM surveys (an absolute estimate) but estimated for the other surveys. Acoustic estimates from the spring egg surveys are not used in the stock assessment.[1]

A key finding of the stock assessments for Pacific Sardine, supported by the ATM surveys, is a declining stock, with increasing concentration in the southern range of the stock off California. The former presence and even abundance of this stock off Vancouver Island in B.C. had been reduced to background biomass. There was concern that the largest and most fecund sardines, thought to migrate further north than smaller fish, were being harvested at levels which would exacerbate population declines primarily caused by poor recruitment[2].

[1] Assessment of the Pacific Sardine Resource in 2012 for U.S. Management in 2013. NOAA-TM-NMFS-SWFSC-501, December 2012.
[2] See Zwolinski and Demer, 2013a,b.

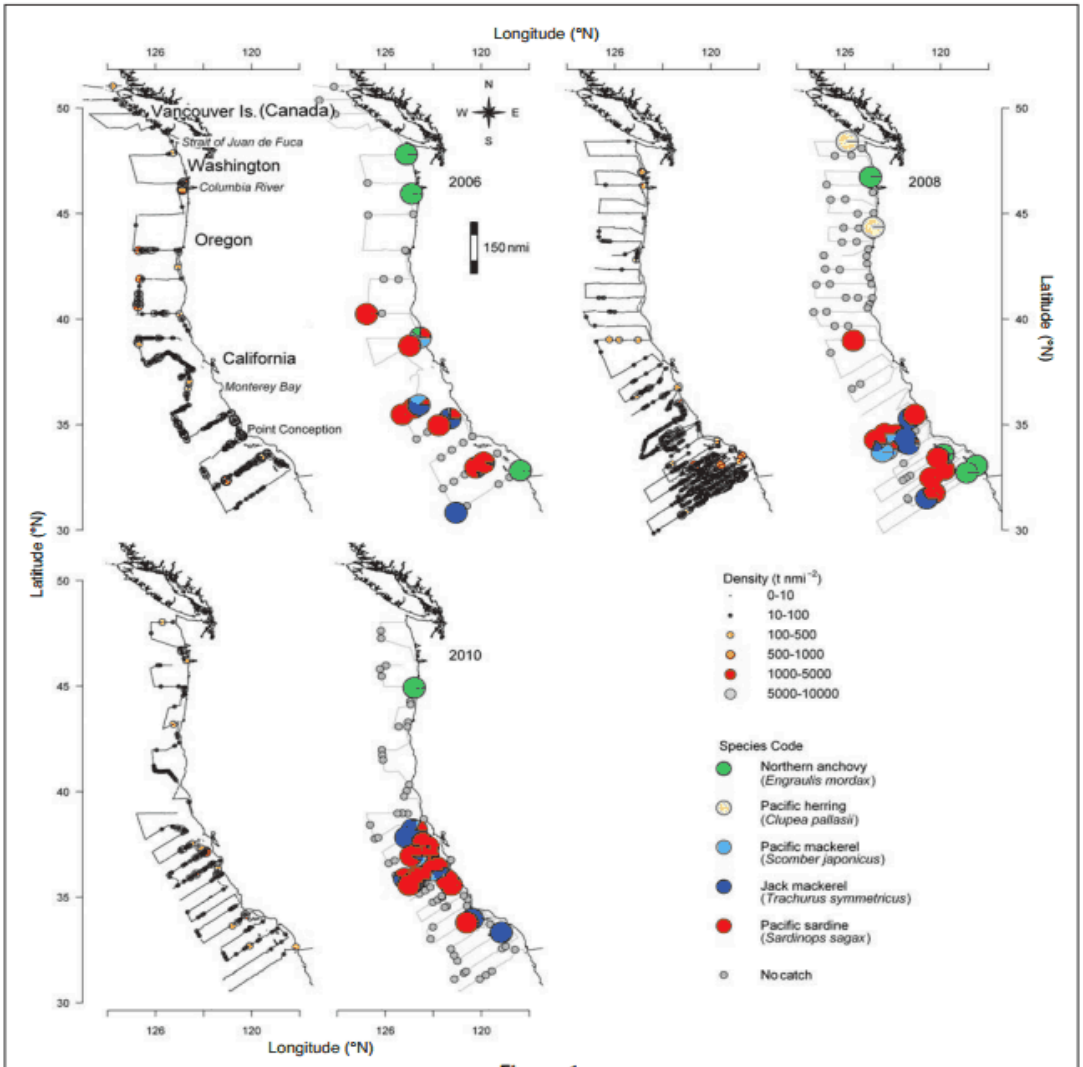

Figure 1

(Left panels) Distributions of biomass densities of acoustically detected coastal pelagic fish species (CPS) (sampling unit=10–70 m depth by 2-km trackline distance), from surveys in spring 2006, 2008, and 2010. (Right panels) Locations and compositions of catches that included at least one CPS specimen; and the locations of trawls with no CPS catch. For each trawl with CPS catch, the proportion of each CPS is represented by the proportion of the area in the circle.

Figure 1. Acoustic-trawl survey results for CPS from 2006, 2008, and 2010[3].

For hake (aka Pacific Whiting), an acoustic-trawl survey targeting age 2+ fish has been conducted since 1977 – although only the data from 1995 onward are used in the stock assessment. The area covered has been consistently between 35.5° and 55° N latitude, and 50 to 1500m depth along the Pacific coast of the U.S. and Canada. Survey timing has been at various times between June and September each survey year. Prior to 2001 the survey was triennial, since then it has been biennial in the odd years. Transects are mostly parallel to lines of latitude, spaced 10 n-miles apart and are assigned a random starting location in the south at the beginning of each survey. The vessels employed generally operate 15 hours a day from sunrise to sunset using 18, 38, 70, 120, and 200kHz, (only 38, 120 on Canadian vessel) transducers; 38 kHz is used for biomass estimation. Mid-water trawls are used to collect species

[3] From Zwolinski et al. 2013a.

composition information to aid in classification of the acoustic backscatter and to collect biological samples on the size and age composition of the hake targets being assessed. Trawl sampling is opportunistic and usually accounts for about 1/3 of each day's operational time.[4] The last hake-only survey in 2011 ran 126 transects covering 4123 n-miles in total (the U.S. vessel *Shimada* and Canadian vessel *Ricker* combined), with the *Shimada* fishing 50 successful mid-water trawl sets and the *Ricker* 28 (Figure follows)[5]. The vast majority of the hake (92%) were located in U.S. waters during the 2011 survey, although in past years this has not always been the case. Warming conditions tend to lead to hake migrations further north into waters off Vancouver Island and the mid-coast of B.C. The total biomass estimate in 2011 was 0.5 million tonnes. Documents provided by NOAA and reviewed are listed in Appendix 2.

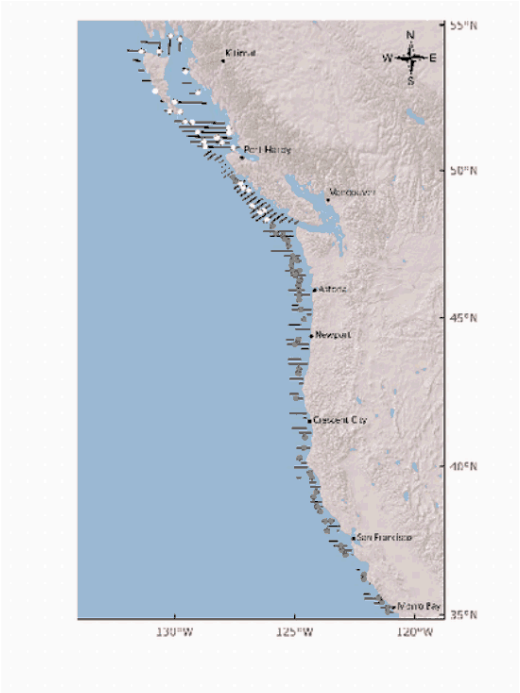

Figure 2. Acoustic transect lines and locations of midwater and bottom trawls during the 2011 integrated acoustic and trawl (IAT) survey of Pacific hake in U.S. and Canadian waters off the Pacific coast. Gray circles represent trawls conducted by the NOAA Ship *Bell M. Shimada*; white circles

Figure 2. Figure 2 from Joint U.S.-Canada Scientific Review Group Report, 2012.

In contrast to the stock assessment of Pacific sardine, the assessment of hake relies near exclusively on the acoustic-trawl survey for estimates of biomass and distribution. This is thought to be a very important point for the important fisheries for this species.

[4] This information comes directly from the Joint U.S.-Canada Scientific Review Group Report from the meeting Feb. 21-24, 2012
[5] NWFSC Cruise Report, Cruise No. SH2011-03, The 2011 Integrated Acoustic and Trawl Survey of Pacific Hake (Merluccius productus) in U.S. and Canadian Waters off the Pacific Coast.

Both the pelagic and hake surveys have been judged to be adequate for informing stock assessments of the status of these stocks[6]. Although there is no need for unnecessary repetition of the findings of those reports, their findings were intensively reviewed as part of background reading and were instrumental in forming an opinion of both the benefits and potential issues with the SaKe combined survey. Indeed, some of the issues pointed out in these previous reviews, such as the potential biases resulting from distribution variability, boat avoidance by pelagics, and unknown or uncertain target strengths, may require additional study in light of a potential change to a SaKe survey design.

The background to the reasons why the SaKe survey was implemented in 2012 (an even year when a hake survey was not planned) requires some discussion (as evident in the meeting from comments by scientists and industry). The total biomass estimate in 2011 was 0.5 million tonnes, which was lower than expected (by industry at least), and could have led to a drastic cut in quota. As the next survey was not scheduled until 2013, there would have been no opportunity to further assess the 2011 results for 2 more years. As 2012 was the year of the pelagic survey, it was dictated that a joint pelagic-hake survey would be planned and conducted with the objectives of providing biomass estimates for hake and also for sardine and perhaps other pelagic species. This merging of the 2 formerly independent surveys involved some changes in the design and the support fishing and oceanographic data collection. It is these changes, and potential losses of information from the independent surveys, that is the focus of this review. In simple terms, we were tasked with addressing whether the pooled surveys could result in their sum being greater than the parts, or whether pooling necessitated the sum being less.

In reviewing the background to the independent surveys, it was evident that these surveys have provided not only useful information for the purposes of stock assessment, but also for research on the life history parameters (distribution, recruitment, growth) and environmental and fishery influences on these and on the resultant performance of these stocks. Much data already exists. Both groups of researchers, and their colleagues, are to be commended not only for their work in carrying out these surveys but in publishing highly informative and useful research on factors that impact past, current and future performance of these stocks. This type of research is thought to be critical to gaining a better understanding of such factors and in providing both the public and industry with a key demand, which typically entails questions of what the future holds for the stocks and the fishery.

It was also evident in the background material that considerable human resources, equipment and ship-time have been allocated for these surveys. This commitment reflects the importance of these fisheries to both the U.S. and Canada (not sure about Mexico). Such importance was highly evident in the meeting as well, and the support that science has from the industry representatives (primarily for the hake fishery) at the meeting was obvious and very positive. This speaks well of the relationship between scientists and industry and bodes well for these surveys and the fishery.

[6] Joint U.S.-Canada Scientific Review Group Report, 2012 and Acoustic-Trawl Survey Method for Coastal Pelagic Species Report on Methodology Review Panel Meeting, 3-5 February 2011

An additional and important point, given the biennial nature of these past surveys, and the possibility that such as strategy may persist, is the importance of the 2012 survey to stock assessment and hence to quotas and the fishery. Given the sporadic nature of strong recruitment in both the sardine and hake stocks, the inter-annual variation in distribution at the time of the surveys and the apparent or coming influence of climate change on distribution, annual surveys are a clear winner all else being equal. This thought will gain traction in this report as a medium term goal.

Finally, the availability of an additional acoustic research vessel *Lasker*, as early as 2015 opens the possibility of reducing by half the current longevity of what should be but are clearly not semi-synoptic surveys. Given the known migratory nature of both sardine and hake in this ecosystem, but unknown and likely variable migration rates, the current near 100 days of survey time risks aliasing densities by either multiple of non-counting of the same fish. This point will be raised later in the review but the availability of a 2nd vessel would greatly assist in countering this potential source of annual bias. The possibility of the new Mexican research vessel co-operating in the survey, making it tri-country, could also alleviate some concerns about sardine distribution in Mexican waters.

My role in the review

I was tasked by the Center for Independent Experts to conduct an independent review of the SaKe surveys for pelagics (CPS) and hake conducted jointly in 2012 and 2013 by the SWFSC and NWFSC with reference to their historical predecessors that were targeted singly at either CPS (SWFSC) or hake (NWFSC). Nonetheless, I was part of a team of scientists that conducted the review made up of myself (Canada), Dr. Jon Helge Vølstad (Norway), Dr. Francois Gerlotto (France), and chaired by Dr. Gary Melvin (Canada). Background material was supplied well ahead of the meeting in Seattle in late January and included organizational material, basic unpublished material such as trip reports and published manuscripts relating the surveys and the fish stocks and ecosystem being reviewed. During the meeting, the review team worked well together both during the meeting and at post-meeting discussions. The breadth of knowledge within the review team was very helpful in formulating views that would be central to the conclusions I have reached and recommendations I have made.

This review was made much easier by the willingness of the scientists, administrators and industry representatives to discuss these surveys, their methods, problems and future very openly, with courtesy and for the most part good humor and friendliness, with only minor bias to their own concerns. The support personnel both prior to and at the meeting were exemplary. That openness and helpfulness was essential to this review and much appreciated.

Summary of Findings for each ToR

1) Review background materials and documents that detail acoustic-trawl survey design and methods, and data analysis methods and results for:

    a. Pacific sardine surveys
    b. Pacific hake surveys
    c. Joint sardine and hake (SaKe) surveys

    This has been done under the background section. The materials and documents were in all cases adequate to assess these surveys.

2) Evaluate the historic, independent sardine and hake survey designs, methods and analytical approaches including data preparations and statistical (e.g. geostatistical) analyses to estimate target species abundances, distributions, and biomasses, and associated uncertainties.

    The historic and independent surveys have been evaluated recently including their survey designs, methods and analytical approaches and were outlined in the Background section of this report. In general, I concur with the finding of those earlier reviews, and will only address here some of the apparent uncertainties associated with those surveys, including those both dealt with and those that were not.

    A fundamental problem with the surveys is that they potentially take too long. Both hake and sardine are migrating in late spring and summer when the surveys take place. In some years both species migrate out of U.S. waters to northern Vancouver Island and even further north in some years. That the migration is variable with ocean climate and the strength of the California Current makes the situation even more difficult. In other years the data indicate an unknown portion of the sardine stock may be in Mexican waters. It is possible that some of the "year-effect" (low or high density estimates from year to year not attributable to a known cause) may be the result of either multiple counts or non-counts of migrating fish. The ideal situation for a survey is a stationary population where the distribution of all members is known. This is not the case here. It would be satisfactory if the northward (in this case) advance of the surveys exceeded the northward movement of the fish, but this is unknown. It is understood that other conditions may dictate a spring-summer survey, including ship availability and inclement weather earlier in the year, hence it is imperative to either reduce the duration of the surveys and/or estimate the migration rates of these species northward. As the rates of migration may very well be variable from year to year, as are the distributions, reducing the survey time would be the optimal solution. More about this later in reviews of the SaKe design, which if anything exacerbates this problem.

Most of the other issues with these surveys are common to all acoustic-trawl surveys conducted around the globe. These were identified in previous reviews. Most of these can cause both bias and imprecision in the acoustic biomass estimates. The historic and present (SaKe) survey biomass estimates for year-classes of hake appear to be relatively sensible for proportions but not so much for absolute values. This situation typically indicates that there are significant "year effects" in the acoustic survey data (biases), such that for unknown reasons in one year the results are low and in another high. In effect this makes the acoustic data less useful, as really it is the fish size from the fishing set data that determine the consistency of the proportionality, and not the acoustic data. So I think there is a need here for research on the potential biases that could cause significant "year effects". These would include bio-ecological factors such as changes in distribution (range), migration rates or vertical distribution (all of these may influence availability to the survey design), in addition to acoustic factors.

Target strength (TS) bias and uncertainty is a common problem. For hake, the length to TS model is as good as any used internationally, but there remains uncertainty about how variable vertical distributions impact the TS of this species. For Atlantic cod, a related species with similar acoustic properties, it has been shown that vertical migration reduces the TS value of individual fish significantly[7]. Hence using the standard model for cod would lead to biased estimates. It is important to stress that variations in mean TS from survey to survey will impact the index of abundance or biomass regardless of whether the index is considered to be relative or absolute.

For the pelagic surveys, the TS of some species is not well known, hence any conversions from backscatter to a biological index must rely on approximations.

There is a need in both survey instances to continue research on TS of at least the principle species, in particular any inter-survey variability. If there is no inter-survey variability, but the mean TS used is not accurate, then the backscatter will lead to a relative index (if the TS is accurate then the index will be absolute). If there is inter-survey variability, then a "year effect" will be present in the data that could be substantial. In such a case the acoustic data become far less useful for stock assessment, which will then largely rely on the proportions of age classes determined by either research trawling or from the fishery.

A similar problem occurs with species identification. Hake appear from the echograms to be fairly well isolated from other species and like most gadoids, not difficult to recognize and classify on modern digital echograms. Nevertheless, it was noteworthy that the cause of one hake survey being biased was thought to be the presence of an abundance of squid. Although how this actually impacted the hake results was not entirely clear, it is possible that the identification of backscatter attributable to hake was made more difficult by the presence of squid. As such

[7] Rose, G.A. Variations in the target strength of Atlantic cod during vertical migration. ICES J. Mar. Sci. 66: 1205-1211.

abundance of squid my re-occur (I do not know how likely this is) some effort should be given to ensure accurate separation can take place.

For the CPS surveys, a different method is used that is based on partitioning backscatter in direct proportion to research trawl data nearby. Several species are involved. This method has a potentially major flaw in that it assumes that the catchability of the various species (and sizes) is equal, which it almost certainly is not. How much bias is introduced into the backscatter portioning is difficult to know. It was reported at the meeting by Dr. Stephane Gauthier from Canada that their method for pelagics has used net mounted cameras to assist in species identification and that this approach was provided very interesting results (no elaboration was given). It was also reported by Dr. David Demer of the SWFSC that they were developing a camera system. Another approach would be to use the various frequency responses in attempts to separate known species (in the beginning of such research different spatial groups of backscatter). If the fish community composition is changing – at present there is evidence that it is – being able to distinguish among species within the acoustic backscatter may become more difficult and more important all at once.

The potential problem of boat avoidance by pelagic species was highlighted in the earlier CIE review. There are various views on this but I do not think a final judgment can be made. Some specific experiments could be done to address this issue, but these have been pointed out in the earlier CIE review and need no reiteration here.

Different analytical methods are used to estimate mean densities based on the sampling done along transects. The hake survey has adapted geostatistical methods whereas the CPS survey uses more conventional statistics. Which is the more useful and appropriate method will depend on the correlation structure both along transects and between transects. If there is no strong correlation then the resultant variogram will be flat and not very useful, and the sampling units can be regarded as being independent samples to be treated with bootstrapping methods. It was not entirely clear at the meeting, or in the documents, what the correlation structure is, and how variable it is in both directions. It would not be appropriate to treat correlation at higher resolution along transects as being the same as between transects. It was not clear what the sampling unit was in terms of distance (this must be known but either I missed it or it was not clear). The bootstrapping methods are more straight-forward but any variance estimate relies on the samples being independent, which is not always true. It would be interesting to see a paper using the historic data and various analytical techniques to see which methods give the more consistent and precise estimates over a period of years.

Under independent survey strategies, analytical methods have been inevitably different. This has not been a problem thus far but bringing research together is likely to have unforeseen synergistic benefits that are unlikely to occur with independent surveys.

3) Evaluate the current joint SaKe survey design, methods, and analytical approaches including data preparations and statistical (e.g. geostatistical) analyses to estimate target species abundances, distributions, and biomasses, and associated uncertainties.

The joint Pacific sardine and hake surveys (SaKe) have initially used a more or less straight combination of the methods used in the historic independent surveys (in 2012 a commercial trawler was used to assist in the hake fishing and the Canadian vessel *Ricker* surveyed hake in Canadian waters – with the U.S. vessel *Shimada* running some lines).

The transect survey design has incredible resolution (Figure 3). The 10 n-mile spacing over much of an extended coastline spanning potentially 3 countries and 20 degrees of latitude (>1200 n-miles) has benefits but also liabilities. As the survey has progressed from S to N, the same general direction of the migration of both sardine and hake, there is a risk of multiple or non-measurement as a result of migration rate (unknown) exceeding survey progress to the north.

There are other issues with the fine spacing of transects. The survey at present takes a long time to complete. Perhaps too long to be considered a synoptic survey, which is what is required by stock assessment. Not only could there be migration effects, but even life history parameters under consideration, such as size and growth, reproductive status and ecosystem measures are unlikely to be stationary over such a long period. It makes sense to attempt to shorten the duration of this survey if at all possible.

Although the survey has as a prime directive producing biomass estimates for stock assessment (for hake the sole index) – the collection of support data for research which will likely benefit not only the understanding of the ecosystem and fishery forces that drive population dynamics, but ultimately the survey and stock assessments. This includes the oceanography. Good examples are the work of Zwolinski and Demer (2013) in attempting to estimate natural mortality of Pacific sardine, Zwolinski et al. (2011) to predict habitat to optimize survey design for Pacific sardine and Agostini et al. (2006) on the relationship between hake distribution and northern flows of the California Current. This research is thought to be essential not only to the understanding of the production of these species, and their resultant fisheries, but also to more efficient surveys and more predictive stock assessments. It appears that the development of the SaKe survey, which was spurred by the low biomass result of the 2011 hake-only survey, led to the hake related oceanography being short-changed somewhat.

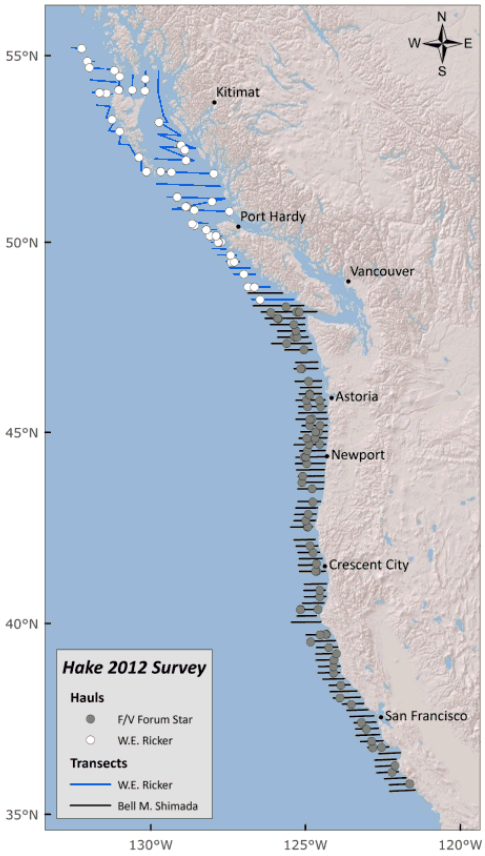

Figure 2. Acoustic transect lines and locations of midwater and bottom trawls during the 2012 joint U.S.-Canada integrated acoustic and trawl (IAT) survey of Pacific hake and Pacific sardine.

Figure 3. Survey transects from 2012 SaKe survey (hake fishing indicated)[8].

The basic methods used for both species have not changed substantially since the merging of the independent surveys. Consistency no doubt has merit but at the same time may limit improvements. It is my opinion that improvements can be made without compromising the consistency of the time series of biomass for either species. I have more on this later in the report.

Having done so, there have been some issues with time allocation for fishing using gear suitable for pelagics and hake, the oceanographic sampling, in particular for hake research, and the allocation of echosounding time. The independent CPS survey used acoustic data only during daylight hours, fishing at night when pelagics migrated vertically to near surface.

At present, the analytical methods used for the CPS and hake are very different. There is nothing essentially wrong with this approach, as the species differ in their distribution patterns and acoustic characteristics. However, it is not acceptable that these analyses be done in total isolation from each other. At a minimum, the results should be cross-referenced to ensure that

[8] From NWFSC Cruise Report, Cruise No. SH2012-04. The 2012 Joint U.S.-Canada Integrated Acoustic and Trawl Survey of Pacific Hake (*Merluccius productus*) and Pacific Sardine (*Sardinops sagax*), February 2013.

echogram classifications are unified and consistent among surveys. This is not difficult to do with Echoview software (which is used by both species groups). What needs to be avoided is independent but inconsistent classifications – such that separations of plankton and hake or hake and CPS are inconsistent. In the end, all extractions from the echogram, no matter the species or information, should come from a single classified echogram source.

4) Evaluate the current tradeoffs, in terms of costs, benefits, and consequences, of transitioning from independent surveys to a joint sardine-hake survey, particularly regarding its potential to provide population trend information to each of the assessments.

Although there have been some difficulties and predictable limitations, the surveys have been successful and the biomass estimates of both species used in the stock assessments. In my view the few misgivings of scientific staff as expressed at the meeting are simply growing pains – this survey has excellent people, outstanding administrative and management support, adequate availability of modern research vessels (with the possible exception of the Canadian component) and strong support from industry. It would be hard to ask for more. It is natural that new surveys will face logistic problems that will have to be refined and evolve with experience. A good example is the difficulty encountered in timing of fishing sets utilizing the 2-boat (acoustics and trawling separate) strategy in 2012 – this was dropped in 2013. Overall, this survey has made a very good start and is fully consistent with both U.S. and international survey strategies to move away from single species surveys to multi-species and towards a more ecosystem-based approach to surveying fish stocks. The existing problems are generally the same as were noted for the independent surveys. Any additional problems associated with the SaKe multi-species survey are few compared to the potential benefits.

I am not in a position to evaluate costs of a transition to a SaKe-type multispecies design, although intuitively the benefits should increase per cost. The benefits are more easily stated. Doing single species or species-group surveys may have attractions but are inherently inefficient and limit the "philosophical" as well as practical design of a survey, from a focus on a narrow set of data that may not be informative about ecosystem dynamics to one of broader thinking and strategies designed to track the performance of several components of ecosystems. It is evident that the narrow approach may give usable data for stock assessments but ignores potential signals in the ecosystem that changes will occur (a very good example is with the northern cod off Newfoundland, a situation with which I am intimately aware, and where classical stock assessments failed to capture the decline of the stock under conditions of declining productivity and reductions of forage fish)[9].

[9] Rose, G.A. 2007. Cod: An ecological history of the North Atlantic fisheries. Breakwater Books, St. John's, NL 496 pp.

5) Evaluate the potential of the SaKe survey design and analysis, or an alternative, to evaluate the status and trends of hake, as managed by the International Hake Treaty, the southern stock of sardine, and other stocks in the Pacific Fisheries Management Council's Coastal Pelagic Fisheries Management Plan (CPS-FMP) including: northern anchovy (northern and central stocks), Pacific mackerel, jack mackerel, market squid, and krill.

The current SaKe survey design and analysis may be able to provide continuing advice to inform stock assessments and hence management agencies in the short term. Nevertheless, I believe that in the longer term this design will fail to address the full suite of assessment and management challenges, in particular those associated with productivity changes in the component species that will likely result from ocean climate dynamics. Having said this, there is no need to throw the baby out with the bathwater. As stated previously, the underpinnings of this survey are very sound, and it is within striking distance of being an exemplary multi-species (even ecosystem in time) acoustic-trawl survey comparable or better than almost any similar survey done worldwide. All the makings are there.

One key problem that needs to be dealt with is the transect intensity (spacing). The objective should be to optimize sampling effort and hence make most efficient use of personnel and ship-time. At present, the 10 n-mile spacing provides a very high resolution for such a survey, but creates problems with respect to fish migration and other factors. But beyond that, if the 10 n-mile spacing is indeed over-sampling the distribution of fish, then a less intense sampling not only would assist in providing a more synoptic survey, but also reduce the likelihood of a migration alias. Given the data from the 2012 and 2103 surveys, tests of the effects of relaxing the transect intensity should be relatively simple to do, and should be done. Ideally, there should be a survey based rational for transect intensity, although in reality for most surveys it depends solely on how much time is available (not a science-based rationale). Here there is an opportunity to base the sampling intensity on the statistics of the data, and hence to make the survey most efficient. An added benefit if transect could be optimized is that it may enable more time for research during the survey.

The provision of advice on the pelagics (CPS) is more complex than that for hake, as it involves additional species. I am not familiar with the acoustic signatures of all of the species mentioned, but experience with other ecosystems and species leads me to believe that there may be acoustic methods based on echogram analyses (multi-frequency most likely) that can assist in species identification. I am not confident that using net hauls with assumed catchabilities of unity will give accurate or consistent proportions for backscatter assignments to species. This is not to say that the trawl data are not useful – they certainly are, but they would be better used in research designed to assign species (and in some cases size) to echogram determinations. Ideally, a library of known acoustic signal would be created from which classification algorithms could be created.

6) Evaluate the tradeoffs, in terms of costs, benefits, and consequences, of:

a) separate hake and sardine surveys every year or every other year, with or without ecosystem sampling

Going down this road would result in the loss of a grand opportunity to work towards a true ecosystem-based survey that provides advice for stock assessment of the main commercial species plus the ecosystem information needed to fully understand productivity changes in those and other species that are currently occurring or are coming at us soon. Furthermore, it would lock independent surveys into a 2-year cycle that could very well miss important events, and would lack robustness to major "year effects" in surveys (hake with market squid or hake 2011 or the swift decline in Pacific sardine). The only advantage I can see is that this would make the ecosystem sampling more straightforward, although it would remain focused on single species every 2 years. There would be no cost savings to the best of my knowledge.

b) joint sardine and hake surveys every year or every other year, with or without ecosystem sampling

Joint sardine and hake surveys (with other species sampled as well) and with ecosystem sampling, every year, is the ideal survey plan. This strategy would have optimal benefits both to stock assessment and supporting ecological research, and to the best of my knowledge would not cost more than competing plans. There are consequences, however, of such a strategy, which should be considered prior to implementation. These will be dealt with, and an alternative joint survey strategy advocated in part c).

c) Alternative joint survey options for hake or sardine every year or every other year, with or without ecosystem sampling, particularly regarding their potentials to: i) estimate population parameters for hake, sardine, and other forage species; ii) put that information into the context of their biotic and abiotic environments: and iii) characterize their roles in the California Current Ecosystem. Provide specific recommendations for short- and long-term improvements to anticipated compromises associated with sardine-hake-ecosystem surveys.

In order to fulfill any part of the potential to put population parameters for hake, sardine, and other forage species into the context of their biotic and abiotic environments (i) and characterize their roles in the California Current Ecosystem (ii), what is termed ecosystem sampling in these Terms of Reference is mandatory. Survey options that do not enable such sampling cannot possibly address. Among historic and current survey designs, only the independent surveys can fulfill these objectives. The present SaKe design does not enable sufficient time to conduct the needed ecosystem sampling, despite its other advantages. I

believe that there is a solution to this, one that will take full advantage not only of the surveys and research past done, but will have as its ultimate goal an evolution from a multi-species to a more complete coastal marine ecosystem survey, done every year.

The five-year research-survey strategy put forth by Dr. Michelle McClure at the meeting is well worth considering. The idea would be to use this time to address problems with the current design and outputs (for assessment and research). I am also considering that the second research vessel (Lasker) will be available in 2015 – the second year of the plan that would begin this year (2014).

A priority for research in the short-term is to determine the optimal transect intensity (spacing). The data exist to determine this from past surveys. If it turns out that a 15 or 20 n-mile transect spacing would sacrifice little in terms of accuracy or precision (more likely) and that this would make little difference to the stock assessments, then much time would be freed up for ecosystem sampling. As stated earlier, a quicker latitudinal progression would make the survey more synoptic hence reducing potential impacts of migration and life history dynamics.

An alternative design would be to use the two U.S. research vessels to conduct the survey. This would reduce the survey duration by approximately half. The Canadian involvement is still required. There are several possible ways to use 2 vessels. I think that the top priority should be to make the survey more synoptic. This dictates separating the vessels, so as not to conduct adjacent transects with both vessels working in one direction, traditionally north to south. Separating the vessels could have several variations. Starting both vessels in the center, both moving south, is thought to be problematic, as there would be a high probability of double counting. Starting one vessel at the north end and the other at the south is less risk prone, but still could double count. If one vessel started at the southern extremity and the other in the middle, both moving north, it would reduce the risk of double counting, but provide no common area for survey comparisons. Starting both vessels in the middle, surveying a common area first, the one heading north, the other south, would provide for comparisons and reduce the risk of double counting the most. There would be a small chance of under counting, but this is preferable to double counting. I have reached this conclusion based on simple reasoning – I stress that I did no formal analyses to back this up.

I think that the ultimate objective should be annual surveys of both sardine and hake with ecosystem sampling. The annual surveys are much better for stock assessments. The problem is that doing the SaKe surveys as they have been conducted would not allow for the ecosystem research, and limits the research time in support of the surveys themselves that would be available during the cruises. I do not think that surveys lacking supporting research is a good way to go. Hence, an additional priority should be the free up sufficient time to be allocated to

research, both ecological and in support of the survey estimates for stock assessment (e.g., target strength, migration). The scientists involved are well aware of these needs, and there is little need here to go into great detail on them, but they must be given the time to do the work. As ship-time is not likely to increase significantly, the optimal strategy is to make the most of what is available now and in the near future – which in reality is quite a bit. Few surveys that I am aware are as well positioned in almost every way to make these advances.

Given that freeing up sufficient time in a full SaKe type survey to do all the research required is unlikely (unless transect intensity could be reduced substantially), the best way forward may be to adopt a 5 year strategy that would involve a full SaKe survey in 2014, 2016, and 2018, with "research" survey years in 2015 and 2017 (Table 1). I stress research "survey" as transect coverage should be of the full U.S. survey area at lower transect intensity, with time allocated for ecosystem and survey research. The intent would be that the lower intensity surveys would be of use to stock assessment, although almost certainly of lower precision. The 2015 survey would be the first to involve 2 U.S. vessels, and would be largely a shake-down research year, but after that would be fully engaged in the survey and research. Using this strategy, it would be anticipated that by 2019 a full annual survey design would be ready that would provide annual biomass estimates of the commercial species (sardine and hake but by that time anchovy may be more important, and there are the mackerels) in addition to the ecosystem research needed to support an ongoing ecosystem-based approach to the surveys. Most of the survey support research should have been done by then, although there should always be room for some of this during surveys.

Another issue is the non-use of U.S. on survey data when no Canadian survey has been done, despite the fact that in most years the vast majority of the hake and sardine are in U.S. waters at the time of the survey. This may be justified – I am not certain. But if the U.S. data show trends that mimic the full survey area there may be justification to use these data in stock assessment. This should be tested with existing data. This may become an issue if Canada cannot support an annual survey but the U.S. can, and also would make better use of historical data.

There is concern about workloads and priorities of the individual scientists and technicians involved (expressed at the meeting). I am not in a strong position to comment on this, but the importance of this survey to the fisheries and to our understanding of the dynamics of the California Coastal Current Ecosystem was clearly evident from administrators and substantial resources have been allocated for this work.

Table 1. Possible survey plan over next 6 years.

Year	Survey type	Vessels*	Design	Transect Intensity
2014	SaKe	Shimada, Ricker	As in 2013	As in 2013
2015	Research	Shimada, Lasker	Middle start, N&S	25 n-miles
2016	Revised SaKe	Shimada, Lasker, Ricker	Middle start, N&S, Ricker N	TBD
2017	Research	Shimada, Lasker	Middle start, N&S	25 n-miles
2018	Revised SaKe	Shimada, Lasker, Ricker	Middle start, N&S, Ricker N	TBD
2019	Full Ecosystem	Shimada, Lasker, Ricker	Middle start, N&S, Ricker N	TBD

* Assuming Ricker is available in those years. I have not considered the new Mexican vessel, but the addition of this vessel would add southern coverage, although involve further co-ordination among agencies and vessels (I cannot comment on that aspect with any authority).

Emphasis on efficiencies in the survey work might include attempts to do more of the analytical work at sea during the cruise. The goal of some surveys is now to have a preliminary estimate ready by the time the boat docks. This may be unrealistic in some cases but as a goal for a new survey design (even if partially achieved) it could save much lab time.

7) Evaluate proposals and provide recommendations to increase the efficacies and efficiencies (e.g., through advanced technologies) of sardine, hake, sardine-hake and sardine-hake-ecosystem surveys, based on Sake 2012 and 2013 survey experiences.

These were only mentioned in very general terms at the meeting, but the opportunities here are great. Some of the issues discussed earlier can be dealt with using newer technologies. The species identification issues may be addressed with camera systems (the Canadian experience appears to support this although I have seen no results from that work yet). There is certainly a need to address the catchability-net issues. More use of the multi-frequency systems on these research vessels might also lead to better classification of echogram images (at a minimum to separate plankton from fish). It was not clear whether or not the synchronization issues of running ADCPs and fisheries echosounders simultaneously have been addressed, but the technology exists to do this if not already done. There is also the issue of boat avoidance by CPS. Given that the distribution of these species at the time of the survey is quite shallow (to 15 m apparently), boat avoidance is highly likely. Research use of forward-looking sonar to address this issue might mollify concerns expressed in the previous CIE review. There is also the potential for multi-beam systems, which may assist with echogram classification and other acoustic issues. It should be stressed,

however, that the single-split beam technologies now used are likely to remain the standard for some time to come, and multi-beam systems which are only beginning to show potential for fisheries research should be used in a research mode only at this stage.

Recommendations

1) That a SaKe-type multi-species acoustic-trawl survey to be conducted by joint teams from the SWFSC and NWFSC replace the historic single species (or CPS group) surveys conducted separately by the SWFSC and the NWFS, with the intent of moving the SaKe survey towards a more complete and annual fisheries ecosystem survey. Negotiations should proceed with Canada (and Mexico) to collaborate with this strategy.

2) That the implementation of the revised survey be done in 2 stages : the first stage being a 5 year plan with alternate years of SaKe survey and a more research focussed survey that would still provide information on both Pacific sardine and hake to stock assessments. The research focused years would cover the full U.S. range of the stocks although the participation of Canada and Mexico is uncertain in those years.

3) The research component of the survey should not be short-changed. This includes ecosystem research on factors influencing productivity of commercial stocks and environmental forcing, and research specifically targeted at improving surveys.

4) To facilitate 1) and 2) and 3), a science-management working group be formed that includes key survey scientists from both the SWFSC and NWFSC. The working group should have an administrative chair and meet at least twice a year to plan the survey and research and work out any logistic difficulties.

5) Research with existing data should be implemented as soon as possible on :

   a. Survey transect intensity (spacing) and impacts on survey biomass and precision (plots of spacing vs. Biomass would result and help determine optimal effort allocation)

   b. Relationship between U.S. survey biomass and total U.S.-Canada biomass to assess if the U.S. stratum could be used to index the state of the full stock

6) Research be implemented to enhance existing interpretations of the acoustic and trawl data. These would include :

   a. Determining rates of movement of hake and sardine on their northward migrations

   b. target strengths and their dynamics

   c. species identification (using cameras to better assess trawl catchability, multi-frequency analyses of echograms)

   d. boat avoidance

Appendix 1: Bibliography of materials provided for review and others cited in this report

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Appendix 2: Statement of Work

External Independent Peer Review by the Center for Independent Experts

Review of Pacific sardine and Pacific hake joint acoustic-trawl survey

Scope of Work and CIE Process: The National Marine Fisheries Service's (NMFS) Office of Science and Technology coordinates and manages a contract providing external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of NMFS scientific projects. The Statement of Work (SoW) described herein was established by the NMFS Project Contact and Contracting Officer's Technical Representative (COR), and reviewed by CIE for compliance with their policy for providing independent expertise that can provide impartial and independent peer review without conflicts of interest. CIE reviewers are selected by the CIE Steering Committee and CIE Coordination Team to conduct the independent peer review of NMFS science in compliance the predetermined Terms of Reference (ToRs) of the peer review. Each CIE reviewer is contracted to deliver an independent peer review report to be approved by the CIE Steering Committee and the report is to be formatted with content requirements as specified in **Annex 1**. This SoW describes the work tasks and deliverables of the CIE reviewer for conducting an independent peer review of the following NMFS project. Further information on the CIE process can be obtained from www.ciereviews.org.

Project Description: The CIE reviewers will serve on a methodology review panel to perform an independent peer review of the Pacific sardine and Pacific hake joint acoustic-trawl survey conducted by the NMFS's Southwest Fisheries Science Center (SWFSC) and Northwest Fisheries Science Center (NWFSC). In 2012, a newly integrated acoustic-trawl survey of both Pacific Hake and Pacific sardine was implemented in waters off the US and Canada. This effort was the result of a unique collaboration and partnership between SWFSC and NWFSC fishery scientists, as well as Canada's Department of Fisheries and Oceans (DFO) and the fishing industry. The survey's primary goal was to measure the distributions and abundances of Pacific hake and Pacific sardine. In addition, oceanographic and environmental data were sampled to estimate the physical oceanographic habitats for each target species. Results of this survey were used in the 2013 assessment of the Pacific hake stock in US and Canadian waters. A review of the joint acoustic-trawl survey of Pacific hake and Pacific sardine will be conducted to review the survey methodology and analytical approaches to estimate abundance, distribution and biomass of Pacific hake and Pacific sardine resources.

Requirements for CIE Reviewer:
Four CIE experts, three independent reviewers and one panel Chair, shall participate in a panel peer review in accordance with the SoW and ToRs herein. The three CIE reviewers shall have the combined expertise and working knowledge in acoustic-trawl survey design, operation, sampling and analysis; ecosystem survey design, operation, sampling and analysis; spatial sampling and analysis with experience in geo-statistics; and familiarity with groundfish and/or coastal pelagic species with annual migration. At least one reviewer shall have working knowledge and expertise in the application of acoustic fish surveys in stock assessments. Experience (and/or familiarity) with acoustic sampling for mid-water, bottom and pelagic species is desirable. In addition to the three CIE reviewers, one CIE expert will serve as Panel Chair. The Panel Chair shall have excellent facilitation and communication skills and expertise in acoustic-trawl surveys and/or one of the areas of expertise outlined above. The primary role of the Panel Chair will be to facilitate an impartial review panel and provide a summary report of the panel proceedings. The Panel Chair may also actively participate in panel discussion and provide feedback during the panel meeting. The CIE reviewer's duties shall not exceed a maximum of 16 days to complete all work tasks of the peer review process. The Panel Chair's duties shall not exceed a maximum of 18 days to complete all work tasks of the facilitation and summary report process. The agenda for the Panel review meeting will be provided to reviewers along with background materials two weeks prior to the panel meeting.

Location/Date of Peer Review: Four CIE experts, one of which will serve as the Panel Chair, shall participate during a panel review meeting in Seattle, Washington to be held January 21-24, 2014.

Statement of Tasks: Each CIE expert shall complete the following tasks in accordance with the SoW, ToRs and Schedule of Milestones and Deliverables specified herein.

Prior to the Peer Review: Upon completion of the CIE expert selection by the CIE Steering committee, the CIE shall provide the CIE expert information (name, affiliation, and contact details) to the COR, who forwards this information to the NMFS Project Contact no later the date specified in the Schedule of Milestones and Deliverables. The CIE is responsible for providing the SoW and ToRs to each CIE expert. The NMFS Project Contact is responsible for providing the CIE experts with the background documents, reports, foreign national security clearance, and information concerning other pertinent meeting arrangements. The NMFS Project Contact is also responsible for providing the Chair a copy of the SoW in advance of the panel review meeting. Any changes to the SoW or ToRs must be made through the COR prior to the commencement of the peer review.

Foreign National Security Clearance: When CIE experts participate during a panel review meeting at a government facility, the NMFS Project Contact is responsible for obtaining the Foreign National Security Clearance approval for CIE experts who are non-US citizens. For this reason, the CIE experts shall provide requested information (e.g., first and last name, contact information, gender, birth date, passport number, country of passport, travel dates, country of citizenship, country of current residence, and home country) to the NMFS Project Contact for the purpose of their security clearance, and this information shall be submitted at least 30 days before the peer review in accordance with the NOAA Deemed Export Technology Control Program NAO 207-12 regulations available at the Deemed Exports NAO website:
http://deemedexports.noaa.gov/compliance_access_control_procedures/noaa-foreign-national-registration-system.html

Pre-review Background Documents: Two weeks before the peer review, the NMFS Project Contact will send by electronic mail or make available at an FTP site to each CIE expert all necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE on where to send documents. Pre-review documents will be provided up to two weeks before the peer review. Any delays in submission of pre-review documents for the CIE peer review will result in delays with the CIE peer review process, including a SoW modification to the schedule of milestones and deliverables. Furthermore, the CIE experts are responsible only for the pre-review documents that are delivered to them in accordance to the SoW scheduled deadlines specified herein.

Panel Review Meeting: Each CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs. **Modifications to the SoW and ToR cannot be made during the peer review, and any SoW or ToR modification prior to the peer review shall be approved by the COR and CIE Lead Coordinator.** Each CIE expert shall actively participate in a professional and respectful manner as a member of the meeting review panel, and their tasks shall be focused on the ToRs as specified in the contract SoW.

The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements, including the meeting facility arrangements.

Contract Deliverables - Independent CIE Peer Review Reports: Each CIE reviewer shall complete an independent peer review report in accordance with the SoW. Each CIE reviewer shall complete the independent peer review according to required format and content as described in Annex 1. Each CIE reviewer shall complete the independent peer review addressing each ToR as described in Annex 2. The CIE expert serving as Panel Chair shall complete a summary report of the panel proceedings including a summary of the individual reviewers' major findings and recommendations. The summary report shall not be a consensus report.

Specific Tasks for CIE Reviewers: The following chronological list of tasks shall be completed by each CIE reviewer in a timely manner as specified in the **Schedule of Milestones and Deliverables**.

1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review;
2) Participate during the panel review meeting in Seattle, Washington during 21-24 January 2014, and conduct an independent peer review in accordance with the ToRs (Annex 2);
3) No later than February 7, 2014, each CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts," and sent to Mr. Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and Dr. David Die., CIE Regional Coordinator, via email to ddie@rsmas.miami.edu. The CIE report shall be written using the format and content requirements specified in Annex 1, and address each ToR in Annex 2.
4) Work with the CIE Chair in providing comments and elaboration on any points raised in the CIE Chair's summary report that might require further clarification.

Specific Tasks for CIE Chair: The following chronological list of tasks shall be completed in a timely manner as specified in the **Schedule of Milestones and Deliverables**.

1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review;
2) Participate as the CIE Chair during the panel review meeting in Seattle, Washington during 21-24 January 2014, and facilitate the panel review maintaining the focus of the peer review in accordance with the ToRs (Annex 2);
3) Produce a Summary Report of the proceedings. The summary report shall not comprise a consensus report and will instead include a synoposis of each term of reference as per the chair's summary of each reviewer's determination. The CIE reviewers should have an opportunity to review and provide comments or elaboration on any points raised in the summary report that they feel might require further clarification. No later than February 21, 2014, the CIE Chair shall submit a Summary Report addressed to the "Center for Independent Experts," and sent to Mr. Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and Dr. David Die., CIE Regional Coordinator, via email to ddie@rsmas.miami.edu. The Summary Report shall address each ToR in Annex 2.

Schedule of Milestones and Deliverables: CIE shall complete the tasks and deliverables described in this SoW in accordance with the following schedule.

17 December 2013	CIE sends the experts' contact information to the COR, who then sends this to the NMFS Project Contact
07 January 2014	NMFS Project Contact sends each CIE reviewer and the CIE Chair the pre-review documents
21-24 January, 2014	The CIE reviewers participate and conduct an independent peer review during the panel review meeting. The CIE Chair facilitates the impartial peer review and participates in panel discussion.
07 February 2014	Each CIE reviewer submits a draft CIE independent peer review report to the CIE Lead Coordinator and CIE Regional Coordinator. These reports will be forwarded to the CIE Chair by the CIE Lead Coordinator
14 February 2014	The CIE Chair submits the working Summary Report to the CIE reviewers
17 February 2014	The CIE reviewers provide their comments and elaborate on any points raised in the summary report that require additional explanation to the CIE Chair
21 February 2014	The CIE Chair submits the draft Summary Report to the CIE Lead Coordinator and CIE Regional Coordinator

28 February 2014	CIE submits the CIE independent peer review reports and CIE Chair's Summary Report to the COR
6 March 2014	The COR distributes the final CIE reports to the NMFS Project Contact and regional Center Directors

Modifications to the Statement of Work: Requests to modify this SoW must be made through the Contracting Officer's Technical Representative (COR) who submits the modification for approval to the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the CIE within 10 working days after receipt of all required information of the decision on substitutions. The COR can approve changes to the milestone dates, list of pre-review documents, and Terms of Reference (ToR) of the SoW as long as the role and ability of the CIE experts to complete the SoW deliverable in accordance with the ToRs and deliverable schedule are not adversely impacted. The SoW and ToRs cannot be changed once the peer review has begun.

Acceptance of Deliverables: Upon review and acceptance of the CIE independent peer review reports and summary report by the CIE Lead Coordinator, Regional Coordinator, and Steering Committee, these reports shall be sent to the COR for final approval as contract deliverables based on compliance with the SoW. As specified in the Schedule of Milestones and Deliverables, the CIE shall send via e-mail the contract deliverables (the CIE independent peer review reports) to the COR (William Michaels, via William.Michaels@noaa.gov).

Applicable Performance Standards: The contract is successfully completed when the COR provides final approval of the contract deliverables. The acceptance of the contract deliverables shall be based on three performance standards: (1) the CIE reports shall have the format and content in accordance with Annex 1, (2) the CIE reports shall address each ToR as specified in Annex 2, (3) the CIE reports shall be delivered in a timely manner as specified in the schedule of milestones and deliverables.

Distribution of Approved Deliverables: Upon notification of acceptance by the COR, the CIE Lead Coordinator shall send via e-mail the final CIE reports in *.PDF format to the COR. The COR will distribute the approved CIE reports to the NMFS Project Contact and regional Center Director.

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Annex 1: Format and Contents of CIE Independent Peer Review Report

1. Each CIE independent peer review report shall be prefaced with an Executive Summary providing a concise summary of the findings and recommendations.

2. The main body of each peer review report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Summary of Findings for each ToR, and Conclusions and Recommendations in accordance with the ToRs.

   a. Reviewers should describe using their own words, the review activities completed during the panel review meeting, including a detailed summary of findings, conclusions, and recommendations.

   b. Reviewers should discuss their independent views on each ToR even if these were consistent with those of other panelists, and especially where there were divergent views.

   c. Reviewers shall provide a critique of the NMFS review process, including suggestions for improvements of both process and products.

   e. Each CIE independent peer review report shall be a stand-alone document for others to understand the proceedings and findings of the meeting, regardless of whether or not they read the summary report. Each CIE independent report shall be an independent peer review of each ToRs, and shall not simply repeat the contents of the summary report.

3. Each report shall include the appendices as follows:

   Appendix 1: Bibliography of materials provided for review
   Appendix 2: A copy of the CIE Statement of Work
   Appendix 3: Panel Membership and other pertinent information from the panel review meeting.

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Annex 2: Terms of Reference (ToR) for the Center for Independent Experts Panel Review of the Joint Pacific Sardine and Pacific hake (SaKe) acoustic-trawl survey

The CIE Chair shall facilitate the panel review on the ToR, and each CIE reviewer shall conduct an independent peer review addressing each ToR;

1) Review background materials and documents that detail acoustic-trawl survey design and methods, and data analysis methods and results for:
    a. Pacific sardine surveys;
    b. Pacific hake survey;
    c. Joint sardine and hake (SaKe) surveys.

2) Evaluate the historic, independent sardine and hake survey designs, methods, and analytical approaches including data preparations and statistical (e.g. geostatistical) analyses to estimate target species abundances, distributions, and biomasses, and associated uncertainties.

3) Evaluate the current joint SaKe survey design, methods, and analytical approaches including data preparations and statistical (e.g. geostatistical) analyses to estimate target species abundances, distributions, and biomasses, and associated uncertainties.

4) Evaluate the tradeoffs, in terms of costs, benefits, and consequences, of transitioning from independent surveys to a joint sardine-hake survey, particularly regarding its potential to provide population trend information to each of the assessments.

5) Evaluate the potential of the SaKe survey design and analysis, or an alternative, to evaluate the status and trends of hake, as managed by the International Hake Treaty, the southern stock of sardine, and other stocks in the Pacific Fisheries Management Council's Coastal Pelagic Fisheries Management Plan (CPS-FMP) including: northern anchovy (northern and central stocks), Pacific mackerel, jack mackerel, market squid, and krill.

6) Evaluate the tradeoffs, in terms of costs, benefits, and consequences, of:
    a. separate hake and sardine surveys every year or every other year, with or without ecosystem sampling
    b. joint sardine and hake surveys every year or every other year, with or without ecosystem sampling,
    c. Alternative joint survey options for hake or sardine every year or every other year, with or without ecosystem sampling,

particularly regarding their potentials to: i) estimate population parameters for hake, sardine, and other forage species; ii) put that information into the context of their biotic and abiotic environments; and iii) characterize their roles in the California Current Ecosystem. Provide specific recommendations for short- and long-term improvements to anticipated compromises associated with sardine-hake-ecosystem surveys.

7) Evaluate proposals and provide recommendations to increase the efficacies and efficiencies (e.g., through advanced technologies) of sardine, hake, sardine-hake and sardine-hake-ecosystem surveys, based on Sake 2012 and 2013 survey experiences.

Agenda
The Center for Independent Experts Panel Review of the Joint Pacific Sardine and Pacific hake (SaKe) acoustic-trawl survey

NOAA Western Regional Center
7600 SandPoint Way NE, Building 1
Workforce Management Conference Room
Seattle, Washington 98115
January 21-24, 2014

Tuesday, January 21, 2014

8:30 a.m. Welcome, Purpose, and Introductions (Michelle McClure and Russ Vetter)

8:45 a.m. Review Meeting Agenda, Terms of Reference and Assignment of Rapporteur Responsibilities (Panel Chair)

Agenda Item A. Introduction and Background: Species Biology and Surveys

9:00 a.m.
i. Biology of Pacific sardine (Russ Vetter)
ii. Biology of Pacific hake (Michelle McClure)
iii. Brief history of the collaborative SWFSC-NWFSC surveys (Michelle McClure)
iv. Focus of this review (Russ Vetter)

10:30 a.m. Coffee Break

Agenda Item B: Historical Individual Surveys

10:45 a.m. History of acoustic-trawl surveys of Pacific sardine (David Demer)

11: 30 a.m. Q & A

12:30 p.m. Lunch

1:30 p.m. History of acoustic-trawl surveys of Pacific hake (Larry Hufnagle)

2:30 p.m Q & A

3:30 p.m. Coffee Break

4:00 p.m. Public Comment

4:15 p.m. Panel Discussion

5:30 p.m. Panel Adjourns for the Day

Wednesday, January 22, 2014

8:30 a.m. Welcome and Schedule Overview

Topic C. Joint SaKe Survey (Strengths and Challenges of Current Solution)

8:45 a.m. Development of Collaborative Sardine and Hake Surveys (SaKe) : Personnel, Equipment, Ships, Transects, and Acoustic, Biological, and Ecological Sampling (David Demer and Larry Hufnagle)

9:45 a.m. Q & A

Wednesday, January 22, 2014 (Continued)

10:30 a.m. Coffee Break

10:45 a.m. Strengths and Challenges of Jointly Conducting the Survey -- Sardine (David Demer)

11:30 a.m. Q & A

12:30 p.m. Lunch

1:30 p.m. Strengths and Challenges of Jointly Conducting the Survey -- Hake (Larry Hufnagle)

2:30 p.m. Q & A

3:30 p.m. Coffee Break

4:00 p.m. Public Comment

4:15 p.m.	Panel Discussion / Report Drafting
5:30 p.m.	Panel Adjourns for the Day

Thursday, January 23, 2014

8:30 a.m.	Welcome, Schedule Overview, and Review of Primary Questions

Topic D. Evaluation of Trade Offs (Strengths and Challenges of Proposed Future Solutions)

8:45 a.m.	Proposals for Annual or Biennial, Single- or Multi-Species Surveys with or without Ecological Sampling (Russ Vetter and Michelle McClure)
9:45 a.m.	Q & A
10:30 a.m.	Coffee Break
12:30 p.m.	Lunch
1:30 p.m.	Panel Discussion
3:30 p.m.	Coffee Break
4:00 p.m.	Public Comment
4:15 p.m.	Panel Discussion / Report Drafting
5:30 p.m.	Panel Adjourns for the Day

Friday, January 24, 2014

8:30 a.m.	Welcome and Overview of the Day
8:45 a.m.	Report Drafting
12:30 p.m.	Lunch
1:30 p.m.	Report Out by Reviewers
2:00 p.m.	NWFSC and SWFSC Leadership Wrap Up with Panel (Closed Session)
3:00 p.m.	Panel Adjourns

Appendix 3: CIE Panel membership and meeting participants for review of the Joint Pacific Sardine and Hake (SaKe) Acoustic-Trawl Survey

Panel Membership:

Gary Melvin, Center for Independent Experts (CIE), Panel Chair
François Gerlotto, Center for Independent Experts (CIE)
George Rose, Center for Independent Experts (CIE)
Jon Helge Vølstad, Center for Independent Experts (CIE)

Participant List:

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Julia Clemons, NMFS, Northwest Fisheries Science Center
Dezhang Chu, NMFS, Northwest Fisheries Science Center
Steve de Blois, NMFS, Northwest Fisheries Science Center
David Demer, NMFS,Southwest Fisheries Science Center
Stephane Gauthier, Department of Fisheries and Oceans, Canada
Owen Hamel, NMFS, Northwest Fisheries Science Center
Jim Hastie, NMFS, Northwest Fisheries Science Center
Allan Hicks, NMFS, Northwest Fisheries Science Center
Lawrence Hufnagle, NMFS, Northwest Fisheries Science Center
Jan Jacobs, American Seafoods Company
Jason Link, NOAA Fisheries, Senior Scientist for Ecosystem Management.
Bev Macewicz, NMFS,Southwest Fisheries Science Center
Michelle McClure, NMFS, Northwest Fisheries Science Center
Bill Michaels, NMFS, Office of Science and Technology
Stacey Miller, NMFS, Northwest Fisheries Science Center
Mike Okoniewski, Pacific Seafood
John Pohl, NMFS, Northwest Fisheries Science Center
John Stein, NMFS, Northwest Fisheries Science Center
Mark Strom, NMFS, Northwest Fisheries Science Center
Ian Taylor, NMFS, Northwest Fisheries Science Center
Rebecca Thomas, NMFS, Northwest Fisheries Science Center
Russ Vetter, NMFS,Southwest Fisheries Science Center
Dan Waldeck, Pacific Whiting Conservation Cooperative
Cisco Werner, NMFS,Southwest Fisheries Science Center
Steven Winter, NMFS, Northwest Fisheries Science Center
Juan Zwolinksi, NMFS,Southwest Fisheries Science Center